Nusrat Abedin Jimi

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PhD Awarded: July 2021
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Summary of Current Research Activity

My research spans multiple subfields of applied microeconomics, including development, labor, environmental, gender, health, and education economics, focusing on how climate change and social inequalities affect human capital and well-being in developing countries. My current priority project examines the effects of climate change-induced salinization in coastal Bangladesh, studying how rising salt levels in drinking water influence households' adoption of safe water sources, as well as the consequent impacts on physical health, mental health, and child development outcomes. In addition to this work, I am pursuing projects on skill formation and labor-market outcomes for disadvantaged youth (through a training intervention in South Asia), on closing gender-based profitability gaps among entrepreneurs in Sub-Saharan Africa, and on the long-term environmental vulnerabilities created by the Green Revolution in agriculture.

Distinctive Perspective

As a faculty member at a liberal arts college on a visiting appointment, I work outside the traditional R1 research-university pipeline. This position has given me a unique perspective on academic research: I have had to be resourceful and proactive in building research collaborations and agendas without the extensive institutional support or networks that large research universities typically provide. Moreover, as an early-career researcher and a mother of two, I understand the challenges of balancing family responsibilities with scholarly ambitions. Navigating these challenges has strengthened my resilience and time management skills, motivating my commitment to fostering inclusive and supportive networks for economists from underrepresented backgrounds.

Furthermore, my field-based and policy-oriented approach to economic research gives me a distinctive lens to contribute to the Summer Institute. I strive to bridge rigorous microeconomic theory with pressing real-world issues of climate adaptation and gender equity in the Global South. Through extensive fieldwork and data collection in communities—from Bangladeshi rural

coastal communities facing climate stress to African markets with gender gaps—I bring **first-hand insights** and a grounded perspective on how economic theory can inform solutions to development challenges. This background will allow me to enrich Summer Institute discussions with practical, on-the-ground empirical experience and a passion for connecting research to policy impact.

What I Hope to Gain from the Fellowship

Attending the 2025 NBER Summer Institute as a REStat Early Career Fellow would provide invaluable opportunities for me to engage with leading scholars in applied microeconomics and immerse myself in vibrant research discussions. I am eager to exchange ideas and receive constructive feedback on my work, which would sharpen my methodologies and improve my ongoing projects. This experience would also greatly increase the visibility of my research and potentially foster new collaborations. By connecting with peers and mentors who are at the forefront of applied microeconomic research, I hope to broaden my professional network and learn about cutting-edge empirical approaches, ultimately strengthening my ability to produce high-quality, policy-relevant research in the years to come.

Sessions of Interest

- Development Economics
- Environmental and Energy Economics
- Labor Studies
- Economics of Health
- Gender in the Economy
- Economics of Education
- Children and Families
- Frontier Econometrics Method
- New Approaches to Uncovering Causal Mechanisms

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Vassar College

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Education

Ph.D., Economics, Binghamton University (SUNY), July 2021
MA, Economics, Binghamton University (SUNY), 2016
M.S.S., Economics, University of Dhaka, Bangladesh, 2012
B.S.S., Economics, University of Dhaka, Bangladesh, 2010

Professional Appointments:

July 2023 - Present	Visitng Assistant Professor, Department of Economics, Vassar College, Poughkeepsie, New York, United States
	Job Responsibilities: Teach economics courses at all levels, advise Econ major students, perform and publish original economic research, be an active scholar and contributor to the field.
July 2021 - June 2023	Faculty Research Associate, Department of Economics, Vassar College, Poughkeepsie, New York, United States
	Job Responsibilities: Conduct quantitative research, communicate with project stakeholders, manage pre-docs and research assistants, publish in academic journal, research talks.
January 2020 – May 2020	Adjunct Assistant Professor, Department of Economics, Binghamton University (SUNY), Binghamton, New York, United States
	Job Responsibilities: Design the course, instruct, assign homework and tests, grade, hold office hours, advise students, complete other responsibilities assigned by the Department.

January 2013 - June 2014	Research Consultant, Leveraging Agriculture for Nutrition in South Asia (LANSA), Dhaka, Bangladesh
	Job Responsibilities: Communicate with national and international stakeholders, quantitative research, scientific report writing, research talks.
July 2012 - June 2014	Research Associate, Development Economics Group, Research and Evaluation Division, BRAC, Dhaka, Bangladesh
	Job Responsibilities: Conducting impact evaluation studies– survey design, develop survey instruments, field management, data analysis and scientific report writing, research talks to national and international stakeholders.

Teaching Experience:

Course Designer and Instructor

Labor Market Inequality and Discrimination – Spring 2025; Spring 2024
Principles of Economics – Fall 2023, Fall 2024
Development Economics – Spring 2025; Spring 2024; Spring 2020; Fall 2018
Principles of Microeconomics – Summer 2017

Graduate Teaching Assistant (2014-2021)

Microeconomic Theory (graduate level) - Spring 2018, Spring 2017; Game Theory - Spring 2016; Microeconomics of Development - Spring 2016; Macroeconomic Theory - Fall 2015; Economics of Fixed Income Markets – Summer 2018; Principle of Microeconomics – Spring 2015, Fall 2014; Principle of Macroeconomics - Fall 2016; Financial Economics – Summer 2020; Summer 2021

Research Grants:

Grant Awarded

(1) "Climate Change Induced Salinization: A Stock take of the current knowledge, practice, and preferences, 2023" Grant Amount: $74,927. Funding Agency: J-PAL K-CAI
(2) "The Impacts of Climate Change Induced Salinization on Worker Productivity in Bangladesh, 2022" Grant Amount: $50,762. Funding Agency: PEDL; J-PAL K-CAI
(3) "Training the disadvantaged youth and labor market outcomes: Long Run Effects of an RCT in Bangladesh," 2019. Grant Amount: $34,000. Funding Agency: NSF Doctoral Dissertation Grant
(4) "School Attendance Under Lottery Systems: Effects on Classroom Diversity and Academic Achievements," 2017. Grant Amount: $5,000. Funding Agency: Lois B. DeFleur International Innovation Fund, Binghamton University.

Honors and Awards:

Binghamton University Graduate Student Excellence Award for Research, 2018-2019
Binghamton University Graduate Student Excellence Award for Teaching, 2019-2020 (finalist)
GSEU Professional Development Award, May 2019, May 2018
NBER Entrepreneurship Research Boot Camp, July 2017

Graduate Assistantship, Department of Economics, Binghamton University, 2014-present
Binghamton University Department of Economics Travel Grant, 2016, 2017
Dissertation Year Fellowship, Economics Department, Binghamton University, Spring 2019

Referee Activities:

Economic Development and Cultural Change; Review of Economics of the Household; Applied Economics; Development Policy Review; Small Business Economics; Poverty & Public Policy

Affiliations:

Youth Policy Forum (YPF) Bangladesh, Bangladesh Young Economist (BYE), Bangladesh Economic Association (BEA)

Workshop and Training:

(1) Evaluating the Impact of Development Programs (2014), The World Bank, IPA, J-PAL, CEGA, and BRAC
(2) Global Staff Training (2013), Poverty Action Lab (J-PAL) and Innovations for Poverty Action (IPA)

Publications:

Jimi, Nusrat (with Nikolov, P and Chang, J.) (2020). "The Importance of Cognitive Domains and the Returns to Schooling in South Africa: Evidence from Two Labor Surveys," *Labour Economics*, 101849.

Jimi, Nusrat (with Kumbhakar, S. Nikolov, P. and Malek, A.) "The Effects of Access to Credit on Productivity: Separating Technological Changes from Changes in Technical Efficiency," *Journal of Productivity Analysis* 52, no. 1-3 (2019): 37-55

Jimi, Nusrat (with Nikolov, P.) "What Factors Drive Individual Misperceptions of the Returns to Schooling in Tanzania? Some Lessons for Education Policy," *Applied Economics* 50, no. 44 (2018): 1-19.

Working Papers:

"Worker Productivity Impacts of Climate Change Induced Salinization," (joint with Shonchoy, A. and Ravindran, S.) Working Paper

"Mind the Data Gaps: An Examination of Women-Owned Enterprise Representation," (joint with Hardy, M. and Kagy, G.) Reject and Resubmit at *Journal of European Economic Association*

"Lottery-Based School Admission: Effects on Classroom Diversity and Academic Achievements," Under Review

"Human Capital and Transformative Entrepreneurship. Evidence from a Regression Discontinuity Design" (joint with Nikolov, P.) Working Paper

Ongoing Projects:

The Double-Edged Harvest: Green Revolution and Public Health in Bangladesh (with Howlader, A.)

Climate Change, Water Salinity and Health Hazards: Role of Subsidy for Behavioral Change and Habit Formation (with Shonchoy, A. and Ravindran, S.)

Training the Disadvantaged Youth and Labor and Marriage Market Outcomes: Evidence from RCT in Bangladesh (with Das, N. and Mahmood, S.)

Foundational Analysis to Close the Gender Profitability Gap (project website)

Conference Presentations:

2024	Southern Economic Association 94th Annual Meeting 2024 Washington, DC, November 2024
	Women in Empirical Microeconomics, University of Chicago, September 26-27, 2024
2022	100 Years of Economic Development, Cornell University, September 2022
	The North East Universities Development Consortium (NEUDC), Yale University, November 2022
	49th Annual EEA Conference, CSWEP session, December 2022
	CSWEP East – American Economic Association, New York, February 2023 (upcoming)
2019	WEAI 94th Annual Conference, San Francisco
2017	Pacific Conference for Development Economics (PacDev)
	Asian Society of Agricultural Economists International Conference
	Dyson Graduate Student Association Seminar, Department of Economics, Cornell University
	NBER Entrepreneurship Research Boot Camp, July 2017
2016	AAEA Annual Meeting, Boston Massachusetts

Research Reports:

"Does Agriculture Promote Diet Diversity? A Bangladesh Study" (with Hossain, M. and Aminul, M.) LANSA working paper, 2016

"Livelihood of Slum-dwellers: Findings from Baseline Survey of Ultra Poor Programme" (with Rahman, Ahmed, Ara, Bhattacharjee) BRAC Research and Evaluation Division, 2016

"Life and Livelihood of the Ultra Poor in Rural Bangladesh: Baseline Findings of CFPR-TUP Programme Phase III" (with Ahmed, S. Bhattacharjee, A. Shams, R. and Ara, J) BRAC Research and Evaluation Division, 2014

"Impact Assessment of Credit Programme for the Tenant Farmer-Baseline Report", BRAC Research and Evaluation Division, 2012

References:

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Worker Productivity Impacts of Climate Change Induced Salinization*

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Abstract

This is the first study to examine the worker productivity impacts of climate change-induced salinization. Using 12 rounds of high-frequency longitudinal data collected from 615 Jute factory workers in Bangladesh, we leverage within-worker temporal variation in water consumption and find that high salt intake is associated with a 1.69 percentage-point reduction in worker efficiency (3%) and a 0.5-day increase (96%) in sickness-related absenteeism among workers older than the median age. Exploiting a natural experiment framework provided by hotter summer months confirms our findings. We document significant heterogeneity by gender and task type, and identify hypertension as the likely mechanism.

Keywords: Salinization, worker productivity, hypertension, coastal Bangladesh

JEL Classification: I15, J24, O10

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1 Introduction

Access to safe drinking water is crucial for safeguarding public health, ensuring quality of life, and maintaining food safety — all of which align with the United Nations Sustainable Development Goals (United Nations, 2024). However, more than 844 million individuals globally are deprived of adequate drinking water, a crisis intensified by climate change-induced salinization (CCIS) in low-elevation coastal zones (Barbier, 2015; Collins et al., 2018; Reimann et al., 2023). The consumption of saline water is closely linked to severe health risks such as preterm delivery due to pre-eclampsia, acute respiratory infections, skin diseases, malnutrition, and hypertension (Caminade et al., 2019; Khan et al., 2011; Rahaman et al., 2020; Vineis et al., 2011). This looming health crisis could also have adverse economic consequences, as worker health is intricately associated to productivity and economic growth (Dupas and Miguel, 2017; Schultz, 2005; Strauss, 1985). In this study, we aim to understand the economic impacts of CCIS by investigating the effects of saline water consumption on worker productivity among low-income coastal populations — an important but underexplored research that requires more academic and policy attention.

The context of our study is Bangladesh, a country apt for the study of CCIS due to its vulnerability to the effects of climate change given its geographic proximity to the ocean and low-lying topography. Over several decades, there has been a significant increase in river salinity in Bangladesh owing to CCIS. This increased salinity has affected the primary drinking water sources in the coastal areas including rivers, ponds (for surface water), and tube wells (for groundwater) (Haque, 2006). Within coastal Bangladesh, we focus on the Jute industry in Khulna — a coastal division that contains two-thirds of the country's total jute factories. Bangladesh accounts for 33% of global jute production and employs an estimated 50,000 workers in this sector (Somoy News, 2023).

A key strength of this study is the rigorous high-frequency longitudinal data collection from 615 workers at a Jute factory in Khulna. We conducted 12 rounds of in-person surveys, beginning with a baseline from October to December 2022, followed by 11 monthly follow-ups throughout 2023. We examine the relationship between high salt exposure and worker productivity after accounting for individual, month, work shift, and day-of-the-week specific effects. The individual fixed effects are crucial as they capture inherent personal characteristics such as genetic predispositions, early childhood exposures, and persistent habits (such as smoking). Our rich dataset also enabled us to account for seasonality and examine the lagged impacts of salt exposure—analyses that would not be possible with data collected at a lower frequency. Furthermore, we utilize the exogenous seasonal variation in groundwater salinity and a natural experiment framework provided by the hotter summer months to identify the causal effect of high salt intake. We collected data on workers' salt intake through their drinking water consumption, calculated by multiplying the quantity of water consumed from each source (i.e., home and factory) by the respective groundwater salinity levels measured directly at factories and workers' homes using dip-based salinity testers. Our

study especially focuses on older workers (above the median age of 34 years), given the vast medical literature documenting that increased age is associated with a significant increase in the prevalence of hypertension with salt intake (Anderson, 1999; Bray et al., 2004; Frisoli et al., 2012; Lionakis et al., 2012; Lloyd-Jones et al., 2005).

We document four key results. First, on the intensive margin of productivity, high salt intake is associated with a 1.69 percentage-point (3% of mean efficiency) decrease in efficiency for workers with above-median age ($p < 0.05$). These magnitudes are larger than the estimated impacts of large particulate matter (PM) pollution shocks on worker productivity among garment sector workers in India (Adhvaryu et al., 2022). Second, on the extensive margin of worker absenteeism, high salt intake for above median-age workers is associated with a 0.48-day (93%) increase in the number of days absent due to sickness ($p < 0.1$). Third, exploiting a natural experiment framework provided by the hotter summer months, this impact intensifies to a 2.59 pp reduction in efficiency ($p < 0.1$) and a 0.78-day increase in absenteeism ($p < 0.05$). Fourth, examining heterogeneous effects, we document significantly larger impacts of high salt intake for male workers and workers engaged in manual work — a decrease of 7 to 8% in mean efficiency ($p < 0.05$) and more than doubled the sick absence rate ($p < 0.05$). We find no evidence of delayed effects from high salt exposure in the previous months — conditional on high salt intake in the current month, high salt intake in past months do not display statistically significant relationships with worker efficiency. This aligns with medical literature, which indicates that the health effects of sodium intake are more immediate and acute rather than delayed (Gupta et al., 2023).

We identify hypertension (high blood pressure) as the potential mechanism for these adverse effects of high salt intake on worker productivity. Our data shows a strong association between high salt intake and hypertension: above median-age workers exposed to high salt intake were six percentage points (53%) more likely to be hypertensive ($p < 0.01$).

The productivity losses that we document are significant for both factories and workers. We estimate a significant loss of USD 10.4 million in monthly revenues for the jute industry alone in Bangladesh. Furthermore, our findings suggest that high salt intake for above median-age workers could cause 144 Taka (approximately USD 1.18) wage losses monthly. In addition to the economic losses, our findings underscore significant public health costs. When scaled to Khulna's 15-64-year-old population, our estimates suggest 3.4 million additional cases of hypertension, leading to an estimated 123,000 Disability-Adjusted Life Years (DALYs) and 5,300 hypertension-related deaths annually. These estimates highlight the urgent need for targeted public health interventions and policy measures, especially given that CCIS-related hypertension remains undetected,[1] and untreated among these vulnerable coastal communities, and the impact is more acute than permanent.

Our study contributes to the literature in several important ways. While there is growing evidence that climate change brings persistent negative impacts in the developing world,

[1] At the baseline 13.33% of our sample was aware of any blood-pressure related issue, whereas we detected the rate of hypertension among upper median sample is 25%.

most studies focus on climate-induced temperature, precipitation, and pollution extremes (Adhvaryu et al., 2022; Banerjee and Maharaj, 2020; Burgess, 2017; Deschenes, 2014; Shah and Steinberg, 2017). To the best of our knowledge, this is the first study to examine the worker productivity impacts of climate change-induced salinization (CCIS). In assessing the potential role of hypertension, we contribute to two further strands of the literature. One strand examines the adverse impact of CCIS on health. Existing studies have documented a strong link between salinity exposure and hypertension, cardiovascular and renal diseases, and infectious disease (i.e., skin diseases, fever, dysentery, and diarrhea) outbreaks in coastal areas globally (Abedin et al., 2012; Gheorghe et al., 2018; Khanam et al., 2015; Rahaman et al., 2020; Scheelbeek et al., 2017). In the context of Bangladesh, studies show that exposure to excessive salinity induces the prevalence of severe health problems in pregnant mothers (i.e., gestational hypertension, (pre)eclampsia, and miscarriages) (Khan et al., 2014,1; Talukder et al., 2016) (Guimbeau et al., 2024) and chronic and acute nutritional deficiency among children (Das et al., 2019).

A separate strand of the literature studies the link between hypertension and worker productivity in developed country settings (Asakura et al., 2021; Hird et al., 2019; MacLeod et al., 2022). Here, the causes of hypertension are primarily due to lifestyle choices including a high-sodium diet. However, there is limited evidence on the relationship between hypertension and worker productivity in developing country contexts, where individuals are exposed to high salt intake due to CCIS and rising groundwater salinity. Moreover, these are also settings where individuals are less likely to have access to medication for hypertension, owing to poor public health capacity and financial constraints. Our results that explore the role played by hypertension in the link between CCIS and worker productivity contribute to this gap in the literature. Our study also speaks to the literature that deals with the adverse impact of external factors on firm productivity, which includes political unrest (Ksoll et al., 2023), electricity outage (Allcott et al., 2016; Fisher-Vanden et al., 2015) and air-pollution (Adhvaryu et al., 2022). We contribute to this literature by demonstrating CCIS-led health impacts on firm productivity.

2 Background and Setting

Our study area is Bangladesh, a country vulnerable to the effects of climate change due to its geographic proximity to the ocean and low-lying topography. Coastal Bangladesh is part of the flat Ganges Delta that streams water from the Himalayas into the Bay of Bengal, and it accounts for 32 percent of the land area and 25.7 percent of the population of Bangladesh (Dasgupta, 2015). River salinity in the coastal area depends on the volume of freshwater discharges from the upstream river systems, the salinity of the Bay of Bengal near the coast, and the circulation pattern of the coastal waters induced by the ocean and strong tidal currents. Since 1948, there has been a significant increase (around 45%) in river salinity due to reduced freshwater inflows from the transboundary Ganges River, elevated sea levels,

siltation of Ganga tributaries, and other rivers. Such changes in salinity in coastal Bangladesh can thus be considered exogenous owing to the nature of the factors outlined above. This increased salinity affects the primary drinking water sources in coastal areas, including rivers, ponds (for surface water), and tube wells (for groundwater) (Haque, 2006). There is a heavy dependency on rainwater, and people face severe drinking water scarcity during the dry seasons due to recurrent droughts (Abedin and Shaw, 2018; Atiq Rahman and Ravenscroft, 2003).

Within coastal Bangladesh, we focus on the Khulna region due to its position as a coastal division threatened by climate change, rising sea levels, and drinking water salinity. The mean sodium concentration in potable water sources in Khulna ranges from 700 to 1500 mg/L, which can easily exceed the WHO recommended level of 2000 mg/L of sodium intake just by drinking 2 to 3 liters of water (Scheelbeek et al., 2017; Shammi et al., 2019).[2] Khulna is also one of the key industrial regions of Bangladesh. Specifically, Khulna is home to two-thirds of the total number of Jute factories in Bangladesh, and private Jute factories in Khulna have seen a significant rise in exports and global market interest in recent years (Desk, 2023). Given this background, we took the Jute industry as a representative industrial sector of the region.

For the purpose of this study, we collaborated with a Jute factory in Khulna to collect high-frequency data on workers. The factory operates in two production units: yarn and jute bags. Both units have different sections that use various types of machinery. There are eight sections in the yarn unit - Batching, Carding, Drawing, Spinning, Roll Winding, Precision Winding, Twisting, and Roping; whereas the jute bags unit has seven sections – Damping, Calendering, Lapping and Cutting, Bangla Loom, S4A Loom (China Loom), Herakle & Hemming, and Hand Sewing. Appendix Table A1 summarizes the activities performed in each section.

There are three different working shift schedules. In the yarn unit, three shifts run continuously for 24 hours: morning (6:00 AM to 2:00 PM), evening (2:00 PM to 10:00 PM), and night (10:00 PM to 6:00 AM). The workers in the yarn unit rotate shifts every 15 days, moving from morning to evening, from evening to night, and night to morning. In contrast, the jute bags unit has a stable schedule: Morning and evening shifts are fixed, while the night shift runs occasionally based on production demand. Approximately 80% of the workforce is employed in the yarn unit. This unit requires relatively less manual work than the jute bags unit because spinning, roll winding, and precision winding involve higher levels of mechanization than looming and Herakle & Hemming, where manual intervention and workmanship are needed.

Workers in our study factory receive a flat wage of 270 Taka (about USD 2.22) per shift, which does not depend on performance or productivity (productivity is not recorded by the factory at the individual level). Our detailed discussion with factory management confirmed

[2] A recommended minimum daily quantity of water for drinking is 5.3 liters (L)/person in Bangladesh (World Health Organization, 2021).

that shift and line managers (and supervisors) can only observe shift-level, unit-level, and line-level outputs. Factory management informed that skilled Jute workers in Khulna are in high demand; as such, workers usually do not lose jobs if they display higher rates of absenteeism. Most of the workers travel to the factory either commuting from their natal villages (the factory provides transportation facilities for this purpose) or stay in the residential hostel provided by the factory.

3 Data and Key Variables

We selected production sections and workers of the factory based on two eligibility criteria: (a) the section should have at least 25 workers, and (b) production output can be measured at the individual level. Six of the 15 production sections satisfied these criteria: Roll winding, Precision winding, and spinning from the yarn unit and Bangla loom, S4A loom (China loom), and Herakle & Hemming from the jute bags unit. Criterion (b) also led us to exclude helpers in the spinning section since their primary roles were to arrange and move yarn.

We implemented a rigorous high-frequency data collection protocol, conducting baseline assessments (first round of data collection) of 615 factory workers from October to December 2022, followed by 11 rounds of follow-up data collection throughout 2023. A majority of the wokers (68%) said that they were born in the area of their current residence. When asked about their reasons for living in their current residence, no one mentioned salinity as a factor. Thus, migration or endogenous relocation away from high-salinity areas is unlikely a concern in our setting. In terms of the distribution of the workers across sections in the factory, we document the following: Roll Winding (45.86%), Precision winding (18.74%), Bangla loom (13.98%), S4A loom (17.21%), and Herakle & Hemming (5.01%).

Data on workers' demographic characteristics, health habits, work experience, and earnings information was collected during the first round of the survey. We also collected the height, weight, and arm circumference of the participants. During each of the subsequent 11 follow-up survey rounds, data on water consumption by source, groundwater salinity, physical and psychological health, blood pressure measurement, and production of each worker was collected. Data on worker absence rates and underlying reasons were collected from follow-up rounds 6 to 11.

We collected a standardized measure of the productivity (efficiency) of the workers across a range of tasks in the Jute factory. First, we recorded the actual production (i.e., product weight, number of pieces of cloth) of each worker along with specific production-related data for each section, which includes information on working time (break times and time wasted due to machine-related issues subtracted from the total shift hours). Next, we calculate a production benchmark or the maximum possible output for each section utilizing the production-related data and industry-standard production formulas. Productivity is then measured by comparing the actual production to the calculated production benchmark, and efficiency is expressed as a percentage. The appendix section B.2 discusses the data collection

process and the efficiency calculation formulae for each section of the factory in detail.[3] We also report an alternative measure of productivity rescaled to the maximum productivity achieved in each section, and report the results in Appendix Table A2. We took several steps to address potential concerns relating to experimenter demand effects throughout our study. More details are available in Appendix B.2.

Digital water salinity testing machines were used to measure the salinity of drinking water at respondents' homes and the factory. We collected information on the amount of water workers usually drink from each source. Workers were given uniquely identified 250 ml bottles the day before an interview to collect the drinking water they typically drink at home. Enumerators collected the bottles from workers during the health data collection. For factory water, samples were collected from four designated sources (two water sources from each production unit) on each survey day. After collecting the samples, water salinity was measured by CON30 TDS (mg/l)/Conductivity (μS/cm)/Salinity (mg/l) testers.

3.1 Summary Statistics

Table 1 provides an overview of the demographic characteristics, health conditions, water consumption and salt intake patterns of the study sample in the baseline. Panel A shows that the average age of the sample workers is 33.48 years, with a standard deviation of 12.47 years. 62.1% of the sample workers are male. Panel B shows the overall nutritional status of the workers. 60.7% of the participants fall within the healthy BMI range of 18.5 to 25. On the other hand, 16.4% are identified as malnourished, based on the Mid-Upper Arm Circumference (MUAC).

Panel C reports the blood and pulse pressure measures of the sample. Hypertension — a systolic blood pressure of 180 mmHg or higher or a diastolic blood pressure of 90 mmHg or higher — is prevalent among 13.3% of the workers. We also calculate pulse pressure, which is the difference between systolic and diastolic blood pressure readings. About 8.1% of our sample workers have a high pulse pressure exceeding 60 mmHg.

Panel D shows the amount of water consumed from home and the factory, along with the salinity levels in the respective water sources. Participants consume, on average, 4.75 liters of water per day — 3.51 liters from home and around 1.24 liters from the factory daily. The salinity of home water is notably high, with a mean concentration of 910.97 mg/L, while factory water has a mean salinity of 792.71 mg/L. This high groundwater salinity results in an average daily salt intake of 3,968.31 mg solely from water consumption.

Appendix Figure A1 shows the variation in average groundwater salinity (mg/L), water consumption (liters), and salt intake from water (mg/day) by month. Our data shows that despite a decrease in groundwater salinity, the total salt intake of factory workers is higher

[3] Our measures of productivity are independent across sections, i.e., productivity declines in one section do not spillover to our measures of productivity for other sections. This is because any waiting time (such as waiting for processed yarn from another section) is included in the break time for workers.

during the summer (May to August).[4] A significant increase in water intake in the hot and humid months (on average, our sample workers drink 0.54 liters more water in summer months compared to non-summer months) compensates for the relatively lower salinity, leading to an overall increase in salt intake compared to the cooler, drier months.

One implication of the high salinity in drinking water sources is its potential effect on the perception of water taste among the population. At baseline, we asked the respondents about the taste of the water, and we noticed that the majority were unaware of the high water salinity. Only 12.5% of participants believe that the taste of their water has changed over the years (Panel E). This lack of awareness among the coastal population underscores the urgent need for targeted policy interventions and public health measures to address the CCIS issue.

Appendix Figure A2 presents the distribution of worker production efficiency as a density plot using the Epanechnikov kernel smoothing method. It shows the variation in worker productivity: worker's efficiency might be on average as little as 35% or as much as 85% efficiency in a given month, with the average efficiency falling around 60%.

4 Empirical Specification

While an ideal experiment to study high salt intake and productivity might randomly assign some workers to have a high salt intake, this is neither ethical nor feasible in practice. We run, as a starting point, the following equation for worker i in shift s on day d of the week at time (month) t:

$$Y_{isdt} = \beta_0 + \beta_1 HighSaltIntake_{it} + \alpha_i + \delta_s + \lambda_d + \gamma_t + \varepsilon_{isdt} \quad (1)$$

where Y_{isdt} is our outcome variable of interest (worker productivity, absenteeism, or a potential mechanism such as hypertension). $HighSaltIntake_{it}$ is defined as an indicator equal to 1 if the worker's salt intake (combined over the home and factory water consumption) was 0.25 SD above the sample mean. Since time-invariant factors such as genetics and gender could affect one's salt intake and productivity, we include individual fixed effects (α_i) that leverage our rich panel data. Since individuals do not change their production unit section, the individual fixed effects also capture production section fixed effects. Thus, average productivity differences across sections and differences in working conditions across sections (such as noise or the difficulty of operating machinery) are accounted for by these fixed effects. The timing of the shift (morning, evening, or night) may also affect salt intake and productivity (for example, productivity may be lower during the night shift due to fatigue or higher due to cooler temperatures at night) and so we include shift fixed effects (δ_s). Similarly, salt intake and productivity may vary by the day of the week and the month of the

[4] We collected monthly average temperature data (°C) from 1991 to 2022 from the Bangladesh climate database. Based on the historical temperature data, we define three seasons: 1) Hot and Humid Summer including May to August with an average temperature of 28.65°C; 2) Autumn including September to November with an average temperature of 26.67°C; and 3) Winter including December to February-March with an average temperature of 23.55°.

year, and so we include day of the week (λ_d) and month fixed effects (γ_t). The coefficient on $HighSaltIntake_{it}$, β_1, is our coefficient of interest. To account for the within-individual correlations over time, standard errors are clustered at the worker level.

Several studies in the medical literature documents that increased age is associated with a significant increase in the prevalence of hypertension with salt intake (Anderson, 1999; Bray et al., 2004; Frisoli et al., 2012; Lionakis et al., 2012; Lloyd-Jones et al., 2005). To study the impact of CCIS on worker productivity for older workers, we run, as our primary specification, the following equation for worker i in shift s on the day d of the week at time (month) t:

$$\begin{aligned} Y_{isdt} = \beta_0 + \beta_1 HighSaltIntake_{it} + \beta_2 AboveMedianAge_i \\ + \beta_3 HighSaltIntake_{it} * AboveMedianAge_i + \alpha_i + \delta_s + \lambda_d + \gamma_t + \varepsilon_{isdt} \end{aligned} \tag{2}$$

where $AboveMedianAge_i$ is an indicator equal to 1 if the worker was above the median age of workers (34 years) in our sample. Here, the coefficient on the interaction term, β_3, is our coefficient of interest.

Despite our rich set of fixed effects, a potential concern with our empirical strategy might be that salt intake is endogenous and potentially correlated with unobservable time-varying factors that are also correlated with productivity. To address this concern, we use a natural experimental framework of summer months in Bangladesh (May to August), which is interacted with groundwater salinity as a triple difference estimator.

We define the variable "High groundwater salinity" based on the weighted average of salinity levels from the workers' home and factory water sources.[5] In this way, we distinguish between salinity and salt intake, to disentangle the endogenous response of workers drinking more water in the hotter summer months. Thus, we run the following alternative specification:

$$\begin{aligned} Y_{isdt} = \beta_0 + \beta_1 HighGroundwaterSalinity_t + \beta_2 AboveMedianAge_i + \beta_3 Summer_t \\ + \beta_4 HighGroundwaterSalinity_t * Summer_t + \beta_5 AboveMedianAge_i * Summer_t \\ + \beta_6 HighGroundwaterSalinity_t * AboveMedianAge_i \\ + \beta_7 HighGroundwaterSalinity_t * AboveMedianAge_i * Summer_t + \alpha_i + \delta_s + \lambda_d + \gamma_t + \varepsilon_{isdt} \end{aligned} \tag{3}$$

where $Summer_t$ is an indicator for the summer months in Bangladesh (May to August) and $HighGroundwaterSalinity_t$ is an indicator variable taking the value 1 when groundwater salinity is more than 0.25 SD above the average groundwater salinity.

[5] These weights do not vary by worker and are determined as the ratio of average water consumed from a source to the total average water consumption for that season.

5 The Impacts of CCIS on Worker Productivity

5.1 Main Results on Efficiency and Absenteeism

Table 2 presents our main results of the effect of CCIS on worker efficiency conditional on showing up for work (i.e. an intensive margin of productivity). While column (1) shows a negative but statistically insignificant relationship between salt intake and efficiency in the overall sample, column (2) highlights that high salt intake is associated with a 1.69 percentage-point decrease in efficiency for workers above median age ($p < 0.05$).[6] On a base productivity of 60% across all workers, this represents about a 3% decrease in productivity. When using our alternative measure of productivity rescaled to the maximum productivity achieved in each section, we estimate that high salt intake is associated with a 1.87 percentage-point decrease in efficiency for workers above the median age (see Appendix Table A2). These magnitudes are larger than the estimated impacts of large particulate matter (PM) pollution shocks on worker productivity — for example, Adhvaryu et al. (2022) estimate that a 1 SD increase in pollution decreases efficiency by about 0.8 percentage points or 1.6% of the mean productivity among garments sector workers in India.

While efficiency is an important intensive margin measure of worker productivity, we also assess the effect of CCIS on the extensive margin of worker absenteeism. Columns (3) and (4) of Table 2 examine the relationship between high salt intake and absenteeism due to sickness. Column (3) highlights that high salt intake is associated with a 0.5-day increase in the number of days absent from the factory due to sickness in the past month ($p < 0.01$). On a base of an average of 0.51 days absent per month, this represents a large, 96% increase in absenteeism. Column (4) shows that for workers above median age, high salt intake is associated with a 0.48-day increase in the number of days absent due to sickness — i.e., a 92% increase ($p < 0.1$).

Taken together, our results highlight large and statistically significant impacts of CCIS on the intensive and extensive margins of worker productivity.

5.2 Main Results Utilizing Variation over Summer Months

As noted in Section 4, a potential concern with our empirical strategy might be that salt intake is endogenous and potentially correlated with unobservable time-varying factors that are also correlated with productivity. To address this concern, we estimate specification 3 and present these results in Table 3 and Table A4. We find that workers exposed to high groundwater salinity in the summer months were 2.59 percentage points less efficient ($p < 0.1$) and had a 0.78-day increase ($p < 0.5$) in sickness absence. These workers were also 6.9 percentage points more likely to be hypertensive ($p < 0.05$) as shown in Table A4. This evidence using an alternative identification strategy adds credibility to our claim that high salt intake has a

[6] Our finding that the relationship between salt intake and efficiency is most salient for older workers is further highlighted in Table A3 and Figure A3.

negative impact on worker productivity.

5.3 Heterogeneous Effects

In Table 4, we focus on two important dimensions of heterogeneity that potentially impact the relationship between CCIS and worker productivity. First, in line with medical literature documenting the heterogeneous effects of blood pressure by gender (see, for example, Lloyd-Sherlock et al. (2014); Pimenta (2012); Safar and Smulyan (2004)), we study the differential impacts on gender. Second, we hypothesize that workers performing tasks that are more physically intensive in nature may be more affected by CCIS. This hypothesis is in line with that of Adhvaryu et al. (2022), who studies whether workers performing tasks that are more cognitively challenging may be more affected by pollution.

The triple interaction term in column (1) highlights that male workers of above median age exposed to high salt intake had 4.8 percentage points (or 8%) lower efficiency relative to female workers of below median age who were not exposed to high salt intake ($p < 0.01$). Furthermore, column (3) highlights that male workers of above median age exposed to high salt intake were associated with a 1.2-day increase in the number of days absent from the factory due to sickness in the past month ($p < 0.05$).

The triple interaction term in column (2) highlights that above-median-age workers engaged in more manual work and exposed to high salt intake had 4.12 percentage points (or 7%) lower efficiency relative to below-median-age workers not engaged in manual work who were not exposed to high salt ($p < 0.05$). In addition, column (4) shows that above-median-age workers engaged in more manual work and exposed to high salt intake were associated with a 1.1-day increase in the number of days absent from the factory due to sickness in the past month ($p < 0.05$). This heterogeneity aligns with findings by Adhvaryu et al. (2022), who find that workers performing tasks with complexity at least 1 SD above the average exhibit productivity losses roughly 3 times the size of those performing less complex tasks.

6 Potential Mechanisms

6.1 Blood Pressure

We focus on high blood pressure as a potential mechanism for our results for two reasons. First, a vast medical literature has documented the impacts of high salt intake on hypertension (Frisoli et al., 2012; He et al., 2005; Youssef, 2022). For example, Scheelbeek et al. (2017) document in a study in coastal Bangladesh that a 100 mg/L reduction in sodium in drinking water was associated with a reduction in systolic/diastolic blood pressure by 0.95/0.57 mmHg, and the odds of hypertension were lower by 14%. Second, a number of studies have established a relationship between hypertension and low productivity (see, for example, Asakura et al. (2021); Hird et al. (2019); MacLeod et al. (2022)). Taken together, blood pressure is a potential mechanism for the relationship between salt intake and productivity.

Table 5 highlights the relationship between high salt intake and blood pressure. As outlined in Appendix B, we use four standard measures of blood pressure: systolic, diastolic blood pressure, hypertension, and high pulse pressure. Column (1) highlights that workers exposed to high salt intake were 3.1 percentage points more likely to be hypertensive ($p < 0.05$). Column (5) further highlights that above median-age workers exposed to high salt intake were 6 percentage points more likely to be hypertensive ($p < 0.1$). On a base of 11.3%, this represents a large, 53% association with hypertension for above median-age workers. Columns (2) and (3) show that workers exposed to high salt intake had 1.23 mmHg higher systolic blood pressure readings ($p < 0.01$) and 0.51 mmHg higher diastolic blood pressure ($p < 0.1$). Similarly, columns (6) and (7) show that above median-age workers exposed to high salt intake had 2.25 mmHg higher systolic blood pressure readings ($p < 0.01$) and 1.39 mmHg higher diastolic blood pressure ($p < 0.05$). Lastly, columns (4) and (8) report impacts on high pulse pressure. Workers exposed to high salt intake were 2.6 percentage points more likely to have high pulse pressure ($p < 0.01$), while above median-age workers were 4.5 percentage points more likely to be have high pulse pressure ($p < 0.01$).[7]

6.2 Mental Health

We also study mental health as a potential mechanism underlying the relationship between high salt intake and productivity. In Appendix Table A6, we study two standard measures of mental health: depression and anxiety (assessed using the Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder (GAD-7) questionnaire). Overall, we do not find any statistically significant relationships between high salt intake and mental health.

Taken together, we find strong evidence of high blood pressure as a potential mechanism underlying the relationship between high salt intake and productivity, but do not find any evidence in favor of a mental health channel.

7 Robustness Checks

Alternative Cutoffs Our estimates are robust to alternative definitions of salt intake using cutoffs that are smaller (0.15 SD above the mean) or larger (0.35 SD above the mean). These results are presented in Appendix Table A7.

Non-linearities To examine potential non-linearities in the relationship between salt intake and our outcomes of interest, we also estimate a quadratic functional form (including the square of $HighSaltIntake_{it}$) in equation 1. These results are presented in Appendix Table A8. We do not find statistically significant non-linearities in the relationship between salt intake and our measures of efficiency and hypertension. This is consistent with the mixed evidence in the medical literature: while some studies have documented non-linear relationships

[7] Our results on hypertension are also consistent with the heterogeneous effects explored in section 5.3. These results are shown in Table A5.

between salt intake and health or performance outcomes (Graudal et al., 2014; Mente et al., 2016), others have not detected such non-linearities (He and MacGregor, 2010; O'Donnell et al., 2014).

Continuous Age Variable Our estimates are also robust using age as a continuous variable, as reported in Appendix Table A3.

Lagged Effects Since our results focus on the relationship between salt intake in the contemporaneous month and efficiency, a potential concern might be that lags of salt intake in previous months may also impact efficiency. Table A9 explores the relationship between lagged salt intake and worker efficiency. In columns (1) and (3), we study the impact of adding the previous month's salt intake (i.e. a one-month lag) to our main regression specification (2). We do not observe any statistically significant impact of high salt intake in the previous month on efficiency and absenteeism for above median-age workers. In columns (2) and (4), we add two additional lags (2 and 3-month lags, respectively). Here too, we do not observe any statistically significant impact of high salt intake in the previous 3 months on efficiency and absenteeism for above median age workers. These regressions suggest that lagged salt intake does not impact worker productivity.

These results are consistent with evidence in the medical literature concerning the short-term relationship between salt intake and high blood pressure. For example, Gupta et al. (2023) found that lowering blood pressure through dietary sodium reduction can be achieved safely and rapidly within one week. Our results on the lack of lagged effects are consistent with the medical literature documenting the short-lived effects of salt intake on blood pressure.

8 Discussion and Conclusion

Using 12 rounds of longitudinal data collected at a high frequency (monthly) from factory workers in Bangladesh, we document statistically significant relationships between climate change-induced salinization (CCIS) and worker productivity. On the intensive margin of productivity (i.e. conditional on showing up for work), we find that high salt intake is associated with a 3% decrease in efficiency for workers above median age. On the extensive margin of worker absenteeism, high salt intake for above median-age workers is associated with a 94% increase in the number of days absent due to sickness. We document significantly larger impacts of 7-8% decreases in efficiency for male workers and workers engaged in manual work.

These losses are significant for both workers and factories. From the factory perspective, we perform a simple back-of-the-envelope calculation to understand revenue losses. We estimate that high salt intake for above median-age workers could lead to a significant loss of USD 10.4 million in monthly revenues for the jute industry alone in Bangladesh. We also

perform a simple back-of-the-envelope calculation to understand wage losses for workers and estimate wage losses of 144 Taka (approximately USD 1.18) monthly.

In addition to the economic losses, our findings underscore significant public health costs arising from disease burden and mortality risks. We use our estimates and hypertension-related age-standardized mortality risk in Bangladesh and disease burden calculations presented in (Islam et al., 2023), and scale impacts to Khulna's 15-64-year-old population. We estimate 3.4 million additional cases of hypertension annually, leading to 123,000 Disability-Adjusted Life Years (DALYs) and an estimated 5,300 hypertension-related deaths.[8] These estimates underscore the urgent need for targeted public health interventions and policy measures, especially given that hypertension mostly remains undetected and untreated among these vulnerable coastal communities.

Fortunately, our examination of hypertension as a potential mechanism offers hope for policy. We rule out lagged effects from high salt intake in previous months (conditional on contemporaneous high salt intake in the current month), consistent with medical literature that documents the short-lived response of blood pressure to salt intake, often within a week. This suggests that interventions aimed at reducing the salt intake among workers could reverse the negative effects on worker efficiency and absenteeism. We leave the exploration of adaptation and mitigation interventions to CCIS for future research.

[8] More details on the calculations for economic and public health costs are presented in Appendix C.

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Tables and Figures

Table 1: Socio Demographic Profile, Water and Salt Intake of Participants

	Mean	SD
Panel A: Demographic Information		
Age (in Years)	33.483	12.471
Male = 1	0.621	0.485
No schooling (1= Yes)	0.125	0.331
Married (1= Yes)	0.605	0.489
N	615	
Panel B: Body Mass Index and Malnourishment		
Healthy (bmi 18.5 to 25)	0.607	0.489
Malnourished (MUAC: Male<=23cm, Female<=22cm)	0.164	0.371
Panel C: Blood Pressure		
Hypertension (Systolic>=180 mmHg or Diastolic>=90 mmHg)	0.133	0.340
Systolic Blood Pressure (mmHg)	117.312	20.307
Diastolic Blood Pressure (mmHg)	73.758	12.347
High Pulse Pressure (Systolic - Diastolic BP > 60 mmHg)	0.081	0.274
Panel D: Drinking Water Source, Groundwater Salinity, Salt Intake via Water		
Water from Home (litre)	3.511	1.854
Water from Factory (litre)	1.238	1.213
Salinity in Home Water (mg/L)	910.966	484.560
Salinity in Factory Water (mg/L)	792.711	196.837
Salt Intake via Water Consumption (mg)	3,968.307	1,920.700
Panel E: Perception on Water Taste		
Water Taste Changed Over Years	0.125	0.331
Water Tastes More Saline | Water Taste Changed	0.471	0.503

Note: The mean values in Panel A report the average age of the workers and, the percentage of workers who are male, have no schooling, and are married. Panel B shows the workers' health status based on BMI and MUAC which we calculated from the recorded height, weight, and arm measurements. Panel C reports the average systolic and diastolic blood pressure and prevalence of hypertension among the study sample. Panel D reports workers' water consumption (in liter) by source, salinity level in the respective water, and workers' total salt intake (in milligrams) via drinking water consumption - the amount of water from each source (i.e., home, factory) multiplied by the groundwater salinity. In Panel E, we report workers' baseline perception of water taste.

Table 2: Effect of Salt Intake (via Water Consumption) on Worker Productivity

	(1)	(2)	(3)	(4)
	Efficiency	Efficiency	Sickness Absence	Sickness Absence
High Salt Intake	-0.390	0.394	0.493***	0.277*
	(0.428)	(0.520)	(0.133)	(0.143)
Above Median Age * High Salt Intake		-1.689**		0.475*
		(0.856)		(0.270)
Individual FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Shift FE	Yes	Yes	Yes	Yes
Day of the Week FE	Yes	Yes	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	60.038		
Mean Salt Intake from Water (mg/day)	3471.985	3471.985		
Average Monthly Absence due to Sickness (Day)			0.514	0.514
Salary Per Shift (BDT)			269.723	269.723
Average Monthly Earnings from this Job (BDT)			6934.182	6934.182
Observations	4344	4344	2186	2186
R-sqr	0.012	0.013	0.017	0.020

Note: This table reports the regression of workers' production efficiency and sickness absence on high salt intake. Columns 1 and 3 show the estimates of equation 1 and Columns 2 and 4 show the estimates of equation 2. 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. 'Sickness Absence' is measured as the total number of days a worker was absent last month due to sickness. 'High salt intake' is a binary variable that takes a value of 1 if the salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Above median age' is a binary variable that takes a value of 1 if the worker's age is above the median age (34 years) of sample workers. Both regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table 3: Effect of High Groundwater Salinity Exposure During Summer Months on Worker Productivity

	(1) Efficiency	(2) Sickness Absence
High Groundwater Salinity	0.197	0.106
	(0.675)	(0.183)
Above Median Age * High Groundwater Salinity	0.388	0.619*
	(1.175)	(0.322)
Above Median Age * High Groundwater Salinity * Summer	-2.587*	0.775**
	(1.530)	(0.356)
Individual FE	Yes	Yes
Month FE	Yes	Yes
Shift FE	Yes	Yes
Day of the Week FE	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	60.038
Average Monthly Absence due to Sickness (Day)	0.514	0.514
Groundwater Salinity in Non-Summer Season (mg/day)	781.695	781.695
Groundwater Salinity in Summer (mg/day)	736.926	736.926
Observations	4402	4675
R-sqr	0.014	0.021

Note: This table shows the effect on workers' efficiency and sickness absence of high groundwater salinity by season. 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. 'Sickness Absence' is measured as the total number of days a worker was absent last month due to sickness. Groundwater salinity is measured as a weighted average of the salinity levels from workers' home and factory water sources, with the weights determined by the seasonal water consumption ratios (the ratio of average water consumed from a source to the total average water consumption for that season). The binary variable "High groundwater salinity" is assigned a value of 1 if the groundwater salinity is more than 0.25 standard deviations above the average groundwater salinity. 'Above median age' takes a value of 1 if the worker's age is above the sample median age. The variable 'Summer' takes a value of 1 if a month falls under the summer season (May to August). Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table 4: Heterogeneous Effect of Salt Intake (via Water Consumption) on Worker Productivity

	(1)	(2)	(3)	(4)
	Efficiency	Efficiency	Sickness Absence	Sickness Absence
High Salt Intake	-0.614	0.144	0.486	0.289
	(0.644)	(0.565)	(0.368)	(0.195)
Above Median Age * High Salt Intake	0.967	-0.123	-0.215	-0.032
	(0.837)	(0.836)	(0.422)	(0.262)
Male * High Salt Intake	1.618*		-0.303	
	(0.967)		(0.387)	
Above Median Age * Male * High Salt Intake	-4.842***		1.190**	
	(1.634)		(0.583)	
Job is Manual * High Salt Intake		0.875		-0.041
		(1.233)		(0.245)
Above Median Age * Job is Manual * High Salt Intake		-4.116**		1.086**
		(1.959)		(0.517)
Individual FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Shift FE	Yes	Yes	Yes	Yes
Day of the Week FE	Yes	Yes	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	60.038		
Mean Salt Intake from Water (mg/day)	3471.985	3471.985		
Average Monthly Absence due to Sickness (Day)			0.514	0.514
Salary Per Shift (BDT)			269.723	269.723
Average Monthly Earnings from this Job (BDT)			6934.182	6934.182
Observations	4344	4344	2186	2186
R-sqr	0.015	0.014	0.024	0.025

Note: This table shows the heterogeneous effect of high salt intake on workers' efficiency by gender and type of work. Columns 1 and 3 show the heterogeneous effect by gender whereas Columns 2 and 4 show the heterogeneous effect by the type of work. 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. 'Sickness Absence' is measured as the total number of days a worker was absent last month due to sickness. 'High salt intake' is a binary variable that takes a value of 1 if salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Above median age' takes a value of 1 if the worker's age is above the sample median age of 34 years. Variable 'Male' indicates whether the worker is male, 0 otherwise. The variable 'Job is Manual' takes a value of 1 if the worker is in the jute bags unit, and 0 otherwise. Both regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table 5: Effect of Salt Intake (via Water Consumption) on Blood Pressure

	(1) Hypertension	(2) Systolic Blood Pressure	(3) Diastolic Blood Pressure	(4) High Pulse Pressure	(5) Hypertension	(6) Systolic Blood Pressure	(7) Diastolic Blood Pressure	(8) High Pulse Pressure
High Salt Intake	0.031**	1.226***	0.511*	0.026***	-0.012	0.202	-0.122	0.006
	(0.013)	(0.407)	(0.281)	(0.008)	(0.010)	(0.484)	(0.383)	(0.010)
Above Median Age * High Salt Intake					0.060***	2.245***	1.387**	0.045***
					(0.017)	(0.815)	(0.555)	(0.015)
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shift FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Section FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day of the Week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hypertension (Systolic>=180 mmHg or Diastolic>=90 mmHg)	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113
Mean Systolic Blood Pressure (mmHg)	112.209	112.209	112.209	112.209	112.209	112.209	112.209	112.209
Mean Diastolic Blood Pressure (mmHg)	70.924	70.924	70.924	70.924	70.924	70.924	70.924	70.924
(systolic pressure - diastolic pressure)> 60 mmHg	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
Observations	4959	4959	4959	4959	4959	4959	4959	4959
R-sqr	0.052	0.109	0.108	0.010	0.019	0.110	0.109	0.012

Note: This table shows the effect of high salt intake on hypertension. 'Hypertension' is an indicator variable that takes a value of 1 if the systolic blood pressure is greater than or equal to 140 mmHg or diastolic blood pressure is greater than or equal to 90 mmHg. Individuals currently taking medication for hypertension are also considered hypertensive. Systolic blood pressure is the pressure in the arteries when the heart contracts (systole). This is usually less than 140 millimeters of mercury (mmHg). Diastolic blood pressure is the pressure in the arteries when the heart is relaxed (diastole), and it is usually less than 90 mmHg in adults. 'High pulse pressure' is a binary variable that takes a value of 1 if the difference between systolic and diastolic blood pressure is greater than 60 mmHg. 'High salt intake' is a binary variable that takes a value of 1 if the salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Above median age' is a binary variable that takes a value of 1 if the worker's age is above the median age of sample workers. Columns 1, 2, and 3 report the estimates of equation 1 whereas Columns 3, 4, and 5 report the estimates of equation 2. All regressions include the fixed effects of the month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

A Appendix Figures and Tables

Figure A1: Groundwater Salinity, Water Consumption, and Salt Intake by Month

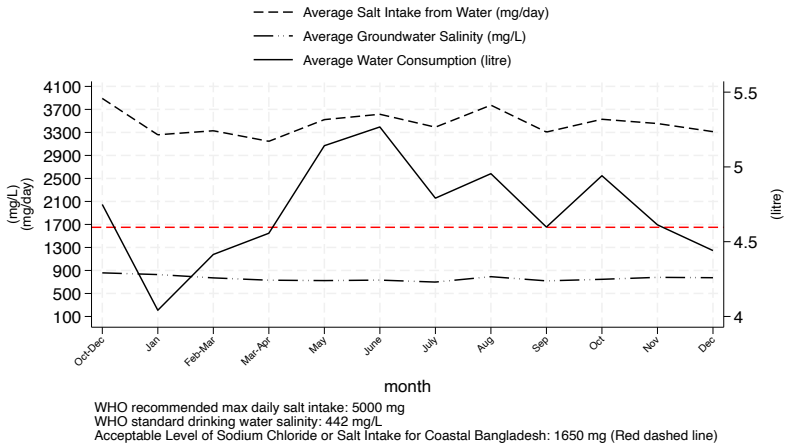


Figure A2: Distribution of Worker Efficiency

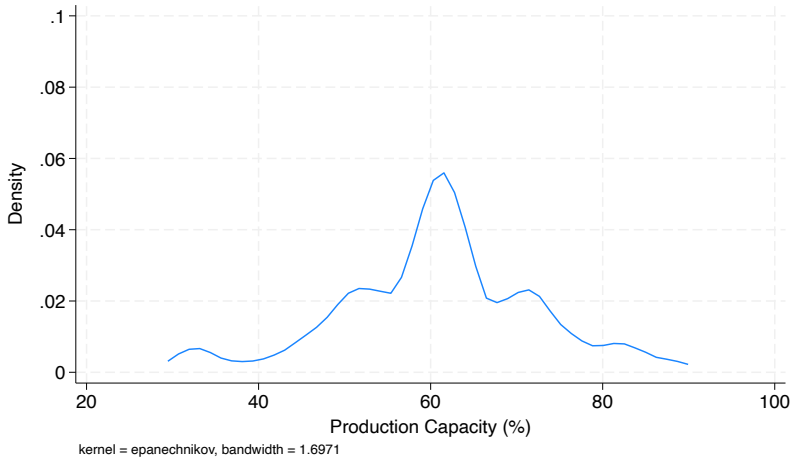
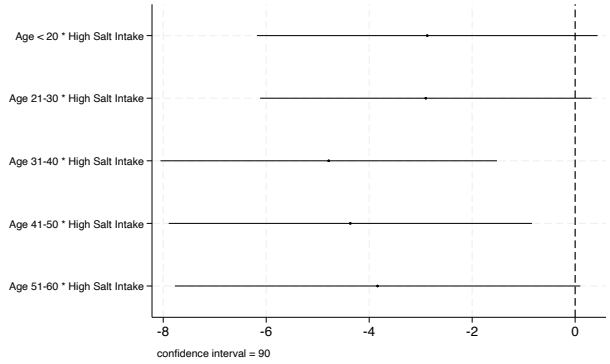
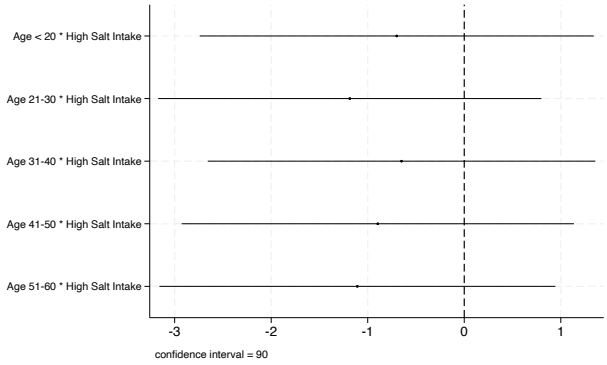


Figure A1 shows the variation in average groundwater salinity levels, water consumption, and salt intake by month. The data indicates that workers' water consumption increases significantly during the hot and humid months (May to August), leading to higher salt intake despite a slight decrease in groundwater salinity. In contrast, water consumption is relatively lower during the dry months (October to February), resulting in lower average salt intake. Figure A2 depicts the distribution of worker efficiency, showing that in a given month, worker's efficiency might be on average as little as 32% or as much as 83% efficiency, with the average efficiency falling around 59%

Figure A3: Effect of Salt Intake (via Water Consumption) on Productivity (by Age Groups)



(a) Efficiency



(b) Sickness Absence

Note: This figure shows the heterogeneous effect of high salt intake on workers' productivity by different age groups. We estimate a modified version of equation 2 (without the individual fixed effects), where indicators of six different age groups and interactions of high salt intake with the age groups are used instead of the 'above median age' indicator. Panel (a) shows the heterogeneous effect on efficiency and Panel (b) shows the effect on sickness absence by age groups. The figure displays the coefficients of the interaction terms of high salt intake and age groups with a 90% confidence interval. The regression includes fixed effects of the month, shift, section, and day of the week. Standard errors are clustered at the worker level.

Table A1: Factory Production Process

Unit 1		Unit 2	
Section	Activity	Section	Activity
Batching	In this section, jute is selected for a batch, piecing up, softening and lubricating, and conditioning or piling.	Damping	Rolled woven cloth is unrolled and water is sprinkled on it continuously to provide desired moisture.
Carding	Jute fibers are formed into ribbons called "sliver". Carding is a combining operation where jute reeds are split and extraneous matters are removed. It is the process by which long reeds of jute pass through high speed-pinned roller and are broken down into an entangled mass and delivered in the form of ribbon with uniform weight per unit length	Calendering	A process similar to the ironing of fabric.
Drawing	A process for reducing sliver width and thickness by simultaneously mixing 4 to 6 slivers together. There are three types of Drawing Frame machines. The first one makes blending, equalizing the sliver, and doubling two or more slivers, level and provide quality and color. The Second Drawing machine makes a more uniform sliver and reduces the jute to a suitable size for the third drawing. The Third Drawing machine is of high speed making the sliver more crimpled and suitable for spinning.	Bangla Loom	Traditional Carpet Weaving using the yarn from the Roll and Precision winding
Spinning	Producing yarn from silver obtained from the Third drawing - Capable of producing quality yarns at high efficiency with auto-doffing arrangements.	S4A Loom (China Loom)	Modern Carpet Weaving
Roll Winding	Provides yarn as spools and cops for beaming and weaving operations.	Lapping and cutting	Fabrics are folded into the required size on the lapping machine while the sacking cloth is cut to the required length for making bags for different sizes under the cutting process.
Precision Winding	wind materials with high accuracy and consistency.	Herakle & Hemming	Hemming stitches the raw edges while the Herakle machine stitches at the side.
Twisting	Used to fold and twist more than one yarn. Helps to produce quality yarns for premium fabrics.	Hand Sewing	Tie and Bundle
Roping	Turning the yarns and threads into plies		

Table A2: Effect of Salt Intake on Worker Productivity (Based on Highest Feasible Efficiency)

	(1) Efficiency	(2) Efficiency
High Salt Intake	-0.331	0.543
	(0.508)	(0.622)
Above Median Age * High Salt Intake		-1.873*
		(1.018)
Month FE	Yes	Yes
Shift FE	Yes	Yes
Section FE	Yes	Yes
Day of the Week FE	Yes	Yes
Mean Production capacity (%)- All Workers	68.282	68.282
Mean Salt Intake from Water (mg/day)	3471.985	3471.985
Observations	4146	4146
R-sqr	0.014	0.015

Note: This table reports the regression of workers' production efficiency on high salt intake. Columns 1 shows the estimates of equation 1 and Columns 2 shows the estimates of equation 2. 'Efficiency' is defined as the ratio of actual output to the section-wise production benchmark (the highest output achieved by workers in a section), expressed as a percentage. 'High salt intake' is a binary variable that takes a value of 1 if the salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Above median age' is a binary variable that takes a value of 1 if the worker's age is above the median age (34 years) of sample workers. Both regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A3: Effect of Salt Intake (via Water Consumption) on Worker Productivity (Age as Continuous Variable)

	(1) Efficiency	(2) Sickness Absence
High Salt Intake	1.933	-0.722
	(1.177)	(0.448)
Age * High Salt Intake	-0.068*	0.029**
	(0.036)	(0.015)
Month FE	Yes	Yes
Shift FE	Yes	Yes
Section FE	Yes	Yes
Day of the Week FE	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	
Mean Salt Intake from Water (mg/day)	3471.985	
Average Monthly Absence due to Sickness (Day)		0.514
Salary Per Shift (BDT)		269.723
Average Monthly Earnings from this Job (BDT)		6934.182
Observations	4344	4617
R-sqr	0.013	0.024

Note: This table reports the regression of workers' production efficiency and sickness absence on high salt intake. Columns 1 shows the estimates of equation 1 and Columns 2 shows the estimates of equation 2. 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. 'Sickness Absence' is measured as the total number of days a worker was absent last month due to sickness.'High salt intake' is a binary variable that takes a value of 1 if the salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Age' is a continuous variable that shows worker's age in years. Both regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A4: Effect of High Groundwater Salinity Exposure During Summer Months on Hypertension

	(1) Hypertension
High Groundwater Salinity	-0.007
	(0.013)
Above Median Age * High Groundwater Salinity	0.020
	(0.022)
Above Median Age * High Groundwater Salinity * Summer	0.069**
	(0.034)
Month FE	Yes
Shift FE	Yes
Section FE	Yes
Day of the Week FE	Yes
Hypertension (Systolic>=180 mmHg or Diastolic>=90 mmHg)	0.113
Groundwater Salinity in Non-Summer Season (mg/day)	781.695
Groundwater Salinity in Summer (mg/day)	736.926
Observations	4961
R-sqr	0.019

Note: This table shows the effect of high groundwater salinity on hypertension. 'Hypertension' is an indicator variable that takes a value of 1 if the systolic blood pressure is greater than or equal to 140 mmHg or diastolic blood pressure is greater than or equal to 90 mmHg. Groundwater salinity is measured as a weighted average of the salinity levels from workers' home and factory water sources, with the weights determined by the seasonal water consumption ratios (the ratio of average water consumed from a source to the total average water consumption for that season). The binary variable "High groundwater salinity" is assigned a value of 1 if the groundwater salinity is more than 0.25 standard deviations above the average groundwater salinity. 'Above median age' takes a value of 1 if the worker's age is above the sample median age. The variable 'Summer' takes a value of 1 if a month falls under the summer season (May to August). Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A5: Heterogeneous Effect of Salt Intake on Blood Pressure (by Gender and Type of Work)

	(1) Hypertension	(2) Hypertension
High Salt Intake	-0.003	0.000
	(0.016)	(0.009)
Above Median Age * High Salt Intake	0.002	0.020
	(0.020)	(0.018)
Above Median Age * Male * High Salt Intake	0.111***	
	(0.034)	
Above Median Age * Job is Manual * High Salt Intake		0.112***
		(0.040)
Month FE	Yes	Yes
Shift FE	Yes	Yes
Section FE	Yes	Yes
Day of the Week FE	Yes	Yes
Hypertension (Systolic>=180 mmHg or Diastolic>=90 mmHg)	0.113	0.113
Observations	4959	4959
R-sqr	0.023	0.022

Note: This table shows the heterogeneous effect of high salt intake on blood pressure by gender. 'Hypertension' is an indicator variable that takes a value of 1 if the systolic blood pressure is greater than or equal to 140 mmHg or diastolic blood pressure is greater than or equal to 90 mmHg. Individuals currently taking medication for hypertension are also considered hypertensive. 'High salt intake' is a binary variable that takes a value of 1 if salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Above median age' takes a value of 1 if the worker's age is above the sample median age of 34 years. Variable 'Male' indicates whether the worker is male, 0 otherwise. The regression includes fixed effects of the month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A6: Effect of Salt Intake on Mental Health

	(1) Depressed	(2) Depressed	(3) Generalized Anxiety Disorder	(4) Generalized Anxiety Disorder
High Salt Intake	-0.004	-0.005	0.004	0.004
	(0.012)	(0.016)	(0.011)	(0.014)
Above Median Age * High Salt Intake		0.003		-0.000
		(0.025)		(0.022)
Month FE	Yes	Yes	Yes	Yes
Shift FE	Yes	Yes	Yes	Yes
Section FE	Yes	Yes	Yes	Yes
Day of the Week FE	Yes	Yes	Yes	Yes
Suffering from Depression(%)	0.213	0.213		
Generalized Anxiety Disorder(%)			0.154	0.154
Observations	4959	4959	4959	4959
R-sqr	0.231	0.231	0.276	0.276

Note: This table reports the regression of workers' mental health indicators on high salt intake. Columns 1 and 3 show the estimates of equation 1 and Columns 2 and 4 show the estimates of equation 2. 'Depressed' is a binary variable based on the PHQ score. It takes a value of 1 if the PHQ score is greater than 0, indicating that the individual has some level of depression or mental health symptoms, and 0 otherwise. The 'Generalized Anxiety Disorder' is a binary variable based on the GAD score. It takes a value of 1 if the GAD score is greater than 0, indicating that the individual has some level of generalized anxiety symptoms, and 0 otherwise. 'High salt intake' is a binary variable that takes a value of 1 if the salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water. 'Above median age' is a binary variable that takes a value of 1 if the worker's age is above the median age (34 years) of sample workers. Both regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A7: Effect of Salt Intake on Worker Productivity (Variation in Cutoff Points)

	(1) Efficiency	(2) Efficiency	(3) Efficiency	(4) Sickness Absence	(5) Sickness Absence	(6) Sickness Absence
High Salt Intake (.15 cutoff)	0.161			0.253*		
	(0.522)			(0.139)		
Above Median Age * High Salt Intake (.15 cutoff)	-1.416*			0.396*		
	(0.826)			(0.239)		
High Salt Intake (.25 cutoff)		0.394			0.277*	
		(0.520)			(0.143)	
Above Median Age * High Salt Intake (.25 cutoff)		-1.689**			0.475*	
		(0.856)			(0.270)	
High Salt Intake (.35 cutoff)			0.545			0.334**
			(0.543)			(0.153)
Above Median Age * High Salt Intake (.35 cutoff)			-2.293**			0.486*
			(0.891)			(0.278)
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Shift FE	Yes	Yes	Yes	Yes	Yes	Yes
Section FE	Yes	Yes	Yes	Yes	Yes	Yes
Day of the Week FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	60.038	60.038			
Mean Salt Intake from Water (mg/day)	3471.985	3471.985	3471.985			
Average Monthly Absence due to Sickness (Day)				0.514	0.514	0.514
Salary Per Shift (BDT)				269.723	269.723	269.723
Average Monthly Earnings from this Job (BDT)				6934.182	6934.182	6934.182
Observations	4344	4344	4344	2186	2186	2186
R-sqr	0.013	0.013	0.014	0.017	0.020	0.022

Note: This table reports the regressions of workers' production efficiency and sickness absence on high salt intake (estimates from equation 2) at different 'High salt intake' cutoff points. 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. 'Sickness Absence' is measured as the total number of days a worker was absent last month due to sickness. 'High salt intake' is a binary variable that takes a value of 1 if the salt intake via water consumption exceeds a certain number of standard deviations above the average salt intake via drinking water (0.15 in columns 1 and 4; 0.25 in columns 2 and 5; 0.35 in columns 3 and 6). 'Above median age' is a binary variable that takes a value of 1 if the worker's age is above the median age (34 years) of sample workers. Both regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A8: Non-linear Effects of Salt Intake on Efficiency and Hypertension

	(1) Efficiency	(2) Hypertension
Salt Intake	-0.00045	-0.00001
	(0.00045)	(0.00002)
Salt Intake Square	0.00000	0.00000
	(0.00000)	(0.00000)
Month FE	Yes	Yes
Shift FE	Yes	Yes
Section FE	Yes	Yes
Day of the Week FE	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	60.038
Mean Salt Intake from Water (mg/day)	3471.985	
Hypertension (Systolic>=180 mmHg or Diastolic>=90 mmHg)		0.113
Observations	4344	4959
R-sqr	0.211	0.189

Note: This table examines the non-linear effect of salt intake via water per day on workers' production efficiency and hypertension. It reports the estimates of a modified version of equation 1 (without the individual fixed effects) including the square of $HighSaltIntake_{it}$). 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. 'Hypertension' is an indicator variable that takes a value of 1 if the systolic blood pressure is greater than or equal to 140 mmHg or diastolic blood pressure is greater than or equal to 90 mmHg. Individuals currently taking medication for hypertension are also considered hypertensive. All regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

Table A9: Lagged Effects of Salt Intake on Efficiency

	(1) Efficiency	(2) Efficiency	(3) Sickness Absence	(4) Sickness Absence
High Salt Intake (One Month Lag)	0.236	0.149	-0.021	0.014
	(0.504)	(0.687)	(0.122)	(0.113)
Above Median Age * High Salt Intake (One Month Lag)	0.229	-0.367	0.391	0.210
	(0.875)	(1.090)	(0.243)	(0.191)
Above Median Age * High Salt Intake		-2.623**		0.593**
		(1.081)		(0.256)
Above Median Age * High Salt Intake (Two Months Lag)		1.381		-0.080
		(1.087)		(0.200)
Above Median Age * High Salt Intake (Three Months Lag)		0.128		0.260
		(1.140)		(0.190)
Individual FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Shift FE	Yes	Yes	Yes	Yes
Day of the Week FE	Yes	Yes	Yes	Yes
Mean Production capacity (%)-All Workers	60.038	60.038		
Mean Salt Intake from Water (mg/day)	3471.985	3471.985		
Average Monthly Absence due to Sickness (Day)			0.514	0.514
Observations	4357	3183	4019	2864
R-sqr	0.014	0.016	0.016	0.020

Note: This table shows the lagged effect of high salt intake (high salt intake in previous months) on workers' production efficiency and reports the estimates of equation 2. 'Efficiency' is the ratio of actual output to the calculated production benchmark (output at machine capacity), expressed as a percentage. The lag salinity variables show workers' high salt intake (due to water consumption) from previous months. For example, 'High Salt Intake (One Month Lag)' takes a value of 1 if the salt intake via water consumption is greater than 0.25 standard deviations above the average salt intake via drinking water a month ago. Similarly, 'High Salt Intake (Two Months Lag)' and 'High Salt Intake (Three Months Lag)' take a value of 1 if the salt intake is greater than 0.25 standard deviations above the average salt intake via drinking water two and three months ago, respectively. 'High salt intake' takes a value of 1 if the salt intake in the current month is greater than 0.25 standard deviations above the average salt intake via drinking water, 0 otherwise. The variable 'High Salt Intake in Last 11 Months' is calculated by adding the number of months the worker had high salt intake (indicated by a value of 1) over the past 11 months. 'Above median age' is a binary variable that takes a value of 1 if the worker's age is above the median age (34 years) of sample workers. All regressions include fixed effects of month, shift, section, and day of the week. Standard errors are clustered at the worker level. * p<0.10, ** p<0.05, *** p<0.01

B Data Appendix

B.1 Variable Definitions

Ground Water Salinity and Salt Intake A worker's total salt intake via drinking water consumption is calculated by multiplying the amount of water from each source (i.e., home, factory) by the groundwater salinity of the respective source and measured in milligrams. The WHO recommends a maximum concentration of 200 mg/L for sodium (Na) and 250 mg/L for chloride (Cl) in drinking water (approximately, 442 mg/L salinity), which has been standardized based on taste threshold, not on health considerations. The standard value of sodium chloride intake adopted by Bangladesh is 150-600 mg/L (approximately, 265-1060 mg/L salinity) (Akter et al., 2016; Benneyworth et al., 2016). However, in case of lack of non-availability of alternative sources, a significantly higher level of chloride intake of 1000 mg/L (approximately, 1650 mg/L of sodium chloride or salt) is considered acceptable for the coastal regions in Bangladesh (Ahmed, 2000; Nahian et al., 2018).

Manual Work $JobIsManual_i$ is an indicator equal to 1 if the worker was assigned to the jute bags unit. This unit performed manual tasks, including Damping, Calendering, Lapping and Cutting, Bangla Loom, S4A Loom (China Loom), Herakle & Hemming, and Hand Sewing.

Absence Due to Sickness Since follow-up six, workers were asked to recall the total number of days they did not come to the factory last month and the reasons behind it. The total number of days in a month a worker was absent due to sickness is used to define the 'Sickness Absence' for that particular month.

Blood Pressure Individual-level blood pressure measures were collected monthly using digital blood pressure monitoring devices. The monitor uses the oscillometric method, a non-invasive way to measure blood pressure using an automated cuff. Field enumerators who collected health information and blood pressure measurements were trained and supervised by a medical health professional who occasionally visited the data collection site.[9] We focus on four standard measures of blood pressure: (1) systolic blood pressure, the pressure in the arteries when the heart contracts (2) diastolic blood pressure, the pressure in the arteries when the heart is relaxed, (3) hypertension, when systolic blood pressure is greater than or equal to 140 mmHg or diastolic blood pressure is greater than or equal to 90 mmHg (Chakraborty et al., 2019; Nahian et al., 2018)[10], and (4) pulse pressure, the difference between the systolic and diastolic blood pressure, representing the force that the heart generates each time it contracts. High pulse pressure is defined as an indicator equal

[9] If the blood pressure is much higher than the normal level (i.e., systolic pressure 200 or more and diastolic pressure below 60 or 65 then the respondent were advised to go to the factory medical center immediately.

[10] Respondents who were taking medication for hypertension at the time of the survey are considered hypertensive.

to 1 if the individual's pulse pressure exceeded 60 mmHg, and 0 otherwise. This can be indicative of increased arterial stiffness or other cardiovascular conditions.

B.2 Production Data Collection Process

Addressing Potential Concerns Relating to Experimenter Demand Effects: We took several steps to address such concerns throughout our study. For example, the research and field management team held meetings with the factory supervisors to explain the study objectives and data collection procedures. We clarified that our goal was to calculate worker productivity for research purposes, and not to evaluate individual performance for the factory. The supervisors understood that this process would not impact workers' job security or their benefits. The supervisors helped ensure that the workers remained unaware of the monitoring of their activities and outputs. Each week, we randomly selected workers to monitor and record their activity and production. Since the enumerators moved around the factory continuously to observe and record data, workers were unaware of exactly which individuals were being monitored. Product weights were also measured and recorded in locations not visible to the workers to maintain anonymity.

Recording Worker Activity and Output: Factory supervisors assisted our enumerators in identifying the machines each worker was operating on specific days. Once located, the enumerators tracked the workers' movements, documenting their activities, breaks, output, and other relevant details on productivity sheets.

In the yarn unit, helpers removed bobbins and spools from the machines, loaded them onto trolleys, and set them aside or took them to the storeroom. Then our enumerators measured the weight of completed spools to ensure workers did not know whose production was being tracked. In the jute bags unit, at the end of their shifts, workers in the Bangla and China Loom sections cut, wrapped, and placed the carpets on the weighing scale before leaving. A tally clerk then measured the products after the workers had left, with the enumerator recording the weights. Workers in the Herakle & Hemming section bundled their products (i.e., jute bags) with labeled names and placed them in the storeroom. Enumerators counted the bags at the end of each shift after the workers had left.

Efficiency Calculation: We calculated a production benchmark or the maximum possible output for each section utilizing the production-related data and industry-standard production formulas. Productivity is then measured by comparing the actual production to the calculated production benchmark, and efficiency is expressed as a percentage. Formulas used for efficiency calculation for different sections are as follows:

Spinning

- **Production Formula (Kilograms)**

$$\frac{\text{RPM} \times \text{Count} \times 60 \times (\text{Working Hours-Break}) \times \text{No. of Spindles}}{\text{TPI} \times 36 \times 14400 \times 2.2046}$$

where, *Working Hours* = 7.5; Break = Prayer + Time lost due to mechanical issue

- **Machine Capacity: (Output at 100% efficiency)**

$$\text{Capacity Output} = \frac{3600 \times 13.75 \times 60 \times (7.5\text{-}0) \times 96}{3.8 \times 36 \times 14400 \times 2.2046} = \textit{490.60 KG}$$

- **Efficiency**

$$\text{Efficiency} = \frac{\text{Actual Output (per worker, in KG)} - \text{Trolley Weight (in KG)}}{\text{Capacity Output} \times \text{Number of Machines Operated}} + \frac{\text{No. of Spindles} \times (\text{No. of Doffing - No. of Empty Bobbin}) \times \text{Weight of single bobbin (in KG)}}{\text{Capacity Output} \times \text{Number of Machines Operated}}$$

Roll Winding

- **Surface Speed (S.S) of Winding Roller (Yards/Min)**

$$\text{R.P.M.} \times \frac{\text{Motor Pulley}}{\text{Machine Pulley}} \times \text{Roller Diameter} \times \frac{\pi}{36}$$

where,

$$\text{R. P. M} \times \frac{\text{Motor Pulley}}{\text{Machine Pulley}} = 1155; \textit{ Roller Diameter } = 3.10 \text{ inches};$$

$$\textit{S.S of winding roller} = \left(\frac{1155 \times 3.10 \times 3.14}{36}\right) = 312.46 \text{ yards/min};$$

- **Production Formula (Kilograms)**

$$\frac{312.16 \times \text{Count} \times 60 \times (\text{Working Hours-Break}) \times \text{No. of Spindles}}{14400 \times 2.2046}$$

where, Break = Prayer + Time lost due to mechanical issue; *Working Hours* = 7.5;

- **Efficiency:**

$$\text{Efficiency} = \frac{\text{Actual Output (per worker, in kilograms)}}{\text{Capacity Output}}$$

Precision Winding

- **Surface Speed (S.S) of Precision Winder (Yards/Min)**

$$\text{R.P.M.} \times \frac{\text{Motor Pulley}}{\text{Machine Pulley}} \times \text{Spool Diameter} \times \frac{\pi}{36}$$

where,

$$\text{Motor R. P. M} \times \frac{\text{Motor Pulley}}{\text{Machine Pulley}} = 450;$$

- **Production Formula (Kilograms)**

$$\frac{450 \times \text{Count} \times 60 \times (\text{Working Hours-Break}) \times \text{Spool Diameter} \times \text{No. of Spool}}{14400 \times 2.2046} \times \frac{\pi}{36}$$

where, Break = Prayer + Time lost due to mechanical issue; *Working Hours* = 7.5; *Spool Diameter* = 10 inches

- **Efficiency:**

$$\text{Efficiency} = \frac{\text{Actual Output (per worker, in kilograms)}}{\text{Capacity Output}}$$

S4A Loom (China Loom)

- **Production Formula (Kilograms)**

$$\frac{\text{Picks per minute} \times 60 \times (\text{Working Hours-Break}) \times \text{Ounce/Yard}}{\text{Shorts} \times 36 \times 16 \times 2.2046}$$

where, *Picks per minute* = 234; *Working Hours* = 7.5 hours[11]; *Ounce/Yard* = 12.41; *Shorts* = 7; Break = Prayer + Time lost due to mechanical issue[12]

- **Machine Capacity (Output at 100% efficiency):**

$$\text{Capacity Output} = \frac{234 \times 60 \times (7.5\text{-}0) \times 12.41}{7 \times 36 \times 16 \times 2.2046} = \textit{147 KG}$$

- **Worker Efficiency:**

$$\text{Efficiency} = \frac{\text{Actual Output (per worker, in kilograms)}}{\text{Capacity Output} \times \text{Number of Machines Operated}}$$

Bangla Loom

- **Production Formula (Kilograms)**

$$\frac{\text{Picks per minute} \times 60 \times (\text{Working Hours-Break }) \times \text{Ounce/Yard}}{\text{Shorts} \times 36 \times 16 \times 2.2046}$$

where, *Picks per minute* = 150; *Working Hours* = 7.5; *Ounce/Yard* = 5.77; *Shorts* = 8; Break = Prayer + Time lost due to mechanical issue

- **Machine Capacity (Output at 100% efficiency):**

$$\text{Capacity Output} = \frac{150 \times 60 \times (7.5\text{-}0) \times 5.77}{8 \times 36 \times 16 \times 2.2046} = \textit{38.34 KG}$$

- **Efficiency:**

$$\text{Efficiency} = \frac{\text{Actual Output (per worker, in kilograms)}}{\text{Capacity Output} \times \text{Number of Machines Operated}}$$

[11] Eight hours shift minus half an hour break for lunch.

[12] If a mechanical problem occurs, workers in the jute bags unit need to wait for the mechanics to arrive and fix the issue. This waiting period affects workers' output as they cannot continue their tasks until the problem is resolved.

Herakle and Hemming

- **Production Formula (Number of Pieces)**

$$\text{(Working Hours-Break)} \times 60 \times \text{Standard production/minute}$$

where, *1 inch* = 2.5 stitches; *Possible stitches in 60 seconds* = 1076; *Standard production rate in Herakle* = 3 pieces/minute; *Standard production rate in Hemming* = 5 pieces/minute

- **Standard Capacity (Output at 100% efficiency):**

$$\text{Capacity Output (Herakle)} = (7.5\text{-}0) \times 60 \times 3 = 1350 \text{ pieces}$$
$$\text{Capacity Output (Hemming)} = (7.5\text{-}0) \times 60 \times 5 = 2250 \text{ pieces}$$

- **Efficiency:**

$$\text{Efficiency [Herakle]} = \frac{\text{Actual Output (per worker, in pieces)}}{1350}$$
$$\text{Efficiency [Hemming]} = \frac{\text{Actual Output (per worker, in pieces)}}{2250}$$

C Calculations for Economic and Public Health Costs

From the factory perspective, we perform a simple back-of-the-envelope calculation to understand revenue losses. On average, the factory had monthly revenues of 139 million Taka (USD 1.19 million) during our study period. Given our 3% efficiency impact, we estimate that high salt intake for above median-age workers could cost the factory USD 35,600 monthly. Across 291 jute mills in Bangladesh[13], this is a significant loss of USD 10.4 million in monthly revenues for the jute industry alone in Bangladesh. We also perform a simple back-of-the-envelope calculation to understand wage losses for workers. The workers are paid by shift and are paid, on average, 270 Taka per shift. Workers work, on average, 1.07 shifts per day. Given our absenteeism impact of 0.5 days per month, we estimate that high salt intake for above median-age workers could cause $270 * 1.07 * 0.52 = 144$ Taka (approximately USD 1.18) wage losses monthly.

In addition to the economic losses, our findings underscore significant public health costs arising from disease burden and mortality risks. Based on the hypertension-related age-standardized mortality risk in Bangladesh and disease burden calculations presented in (Islam et al., 2023), we estimate that approximately 27% of workers in our sample could develop hypertension due to high salt exposure, leading to an estimated 0.26 hypertension-related deaths and 6.12 Disability-Adjusted Life Years (DALYs).[14] When scaled to Khulna's 15-64-year-old population of approximately 12.3 million, this suggests annually 3.4 million additional cases of hypertension, leading to 123,000 Disability-Adjusted Life Years (DALYs) and an estimated 5,300 hypertension-related deaths.

[13] https://www.juteyarn-bjsa.org/statistical-information/

[14] Our findings show that high salt exposure is associated with a 27.4% increase in hypertension (baseline hypertension is 11.3 percent and high salt exposure is associated with an increase in this rate by 3.1 percentage points). Therefore, approximately 169 additional workers out of the 615 (0.274*615) would be expected to have hypertension due to high salt exposure. Islam et al. (2023) note that the age-standardized death rate due to hypertension in Bangladesh was 155.74 per 100,000 in 2019. Taken together, the increase in hypertension-related deaths due to high salt exposure in our sample would be approximately 0.26 deaths (155.74/100000*169).